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13. ABSTRACT (Maximum 200 words) <p>The researchers were visited by Prof Christopher Durning from the Dept of Chemical Engineering at Columbia University. Prof Durning has an extensive background in experimenting with several kinds of anomalous polymers (including Case II materials). In almost daily seminars Prof Durning and Cohen, together with several of Cohen's grad students, formulated both a theoretical and experimental attack on problems arising in the strength and use of new materials and in problems from certain considerations in environmental chemistry. For example, new strong light weight materials for use in both commercial and military vehicles will have many non-planar shapes. Thus, these materials will sometimes be subject to compression (on the concave side of a bent sheet) and sometimes to tension (on the convex side.) Experiments yield greatly differing results in the two cases. The researchers need to incorporate the physics of these situations into their Case II diffusive model and accurately formulate the physics at the interfacial moving boundary. For the problems involving polymer films for use in protective clothing and uniforms and as separating membranes in environmental protective and clean-up devices, chemical effects often take place at the moving interface. The researchers have now formulated tractable models for many of these problems.</p>				
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Dear Arje:

FINAL (PER AN)

Technical Report
Air Force Grant AFOSR-91-0045

1 Oct 90 - 30 Sep 93

The goal originally set for this period was achieved, namely, a study of almost all the major diffusive phenomena for Case II diffusion. Representative model problems were formulated and solved using one-dimensional fixed boundary problems. We feel we now have discovered almost all of the proper scalings in the various relevant parameter regions so that we understand the dominant physical effects.

During this report period, due to support from the AFOSR grant, we were visited by Professor Christopher Durning from the Department of Chemical Engineering at Columbia University. Professor Durning has an extensive background in experimenting with several kinds of anomalous polymers (including Case II materials). In almost daily seminars Professor Durning and Cohen, together with several of Cohen's grad students, formulated both a theoretical and experimental attack on problems arising in the strength and use of new materials and in problems from certain considerations in environmental chemistry. For example, new strong light weight materials for use in both commercial and military vehicles will have many non-planar shapes. Thus, these materials will sometimes be subject to compression (on the concave side of a bent sheet) and sometimes to tension (on the convex side). Experiments yield greatly differing results in the two cases. We need to incorporate the physics of these situations into our Case II diffusive model and accurately formulate the physics at the interfacial moving boundary. For the problems involving polymer films for use in protective clothing and uniforms and as separating membranes in environmental protective and clean-up devices, chemical effects often take place at the moving interface. We now have well formulated tractable models for many of these problems.

We must now use all our previously developed theory, appropriately modified and extended, to solve the far more difficult free and moving boundary problems necessary to model the phenomena. In collaboration with Professor Durning, we have made an excellent start here. Furthermore, Professor Durning is designing experiments to verify the functional forms and measures the transport coefficients in our theory and to identify the dominant physical mechanisms at moving glass-rubber interfaces. In addition to David Edwards, who is close to finishing his thesis work, two new graduate students, Thomas Witelski and Celeste Chang have started to work in these new fields.

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Dr. Arje Nachman/March 17, 1993
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I have been asked by SIAM to give an invited talk on these problems at the SIAM National Meeting in Philadelphia in July, 1993, and Professor Durning and I are organizing a two-session mini-symposium on non-Fickian diffusion to be held at the same meeting.

As always, I would like to thank you for your support.

Sincerely yours,

Don

Donald S. Cohen
Professor of Applied Mathematics

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